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He and Ne as tracers of natural CO₂ migration from a deep reservoir

(Abstract)

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He and Ne as tracers of natural CO₂ migration from a deep reservoir

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Capture and geological storage of CO₂ is emerging as an attractive means of economically abating anthropogenic CO₂ emissions from large point sources. However, for the technology to be universally deployed it is imperative that a reliable method to assess the integrity of a storage site for both safety and regulation compliance exists. Hence, the ability to track, and identify the origin of, any CO₂ seepage measured at the near-surface and ground surface is critical.

As an analogue for post-emplacement seepage, this presentation will examine natural CO₂ rich springs and groundwater wells in the vicinity of the St. Johns Dome CO₂ reservoir, located on the southern tip of the Colorado Plateau on the border of Arizona and New Mexico. Extensive travertine deposits in the vicinity of St. Johns document a long history of the migration of CO₂ rich fluids to the surface. Whilst travertine formation appears to be insignificant at present, there is strong evidence of the migration of CO₂ rich fluids to the surface as shown by high levels of HCO₃⁻ in the surface spring waters.

Noble gases are conservative tracers within the subsurface, and combined with carbon stable isotopes, have proved to be extremely useful in determining both the origin of CO₂ and how the CO₂ is stored within natural CO₂ reservoirs from around the world including St. Johns Dome [1,2]. This presentation will compare measurements of the dissolved ³He/⁴He, CO₂/³He, ³He, ⁴He and ²⁰Ne concentrations from surface spring and groundwater well waters with those from the deep CO₂ reservoir. We show that a component of the helium fingerprint observed in the gaseous CO₂ contained in the St. Johns reservoir can be traced in waters from both the groundwater wells and the springs emerging at the surface above the reservoir. Our results show that CO₂ can be traced from source to surface using noble gases and illustrates that this technique could be used to identify CO₂ migration from engineered storage sites.

[1] Gilfillan et al., (2008) *GCA* **72**, p.1174-1198. DOI:10.1016/j.gca.2007.10.009

[2] Gilfillan et al., (2009) *Nature*, **458**, p.614-618. DOI:10.1038/nature07852